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BY FACSIMILE
CONFIRMATION BY POST

Dear Sirs

International Patent Application No. PCT/GB 03/01943
Cambridge Positioning Systems Ltd.
Our Ref: MJB07237WO

In response to the Written Opinion of 11 May 2004, enclosed please find, in triplicate, replacement pages 8 to 15A and 22 to 30 to replace pages 8 to 15 and 22 to 30 at present on file.

The Examiner had raised, in paragraph 1 of the Written Opinion, a number of objections regarding the terminology used in the specification and claims. The claims have been amended so as to define, in the terms used in the description on pages 16 to 20, the terms "blurred estimate" and "blurred terminal section" etc. so that, by these definitions, any lack of clarity with the original claims disappears.

The Examiner also objected to terminology such as "section of a representation". However, we believe that the Examiner will recognise that once a received signal has actually passed through a radio receiver and an output has been created, the output is not actually what was received, but, rather, is always a representation of the received signal. Furthermore, a section of the representation is simply a snapshot or a portion of the output signal and we believe therefore that these terms do not lack clarity and, given in particular the extensive description, would be readily apparent to the skilled reader.

Turning now to comments from the Examiner regarding the cited prior art, with respect, the Examiner's suggestion that the document D1 discloses all the features of (say) claim 1, is not correct. While the Examiner may be correct that the features that he has labelled "i" to "iii" may be found in the

D1 reference, neither items iv or v can be found in the D1 reference. The "first function" defined in claim 1 is dependent upon both the first section and the section created at the terminal and there is no equivalent step in D1 which merely makes an estimate from a mathematical model of the channel profile, rather than from a measurement as defined by claim 1. This is a crucial difference because the function derived from the mathematical model can only ever be an approximation to the actual measurement. As regards section v, the Examiner is wrong in suggesting that the correlator carries out the creation of a second function and uses this with the terminal section to create a blurred terminal section.

It may be helpful for the Examiner to recognise that everything that is described in the D1 reference, in regard to Figure 4 in particular, relates to a process which is carried out solely in the terminal. In the example described in the present specification it is quite clear that sampling devices located at the transmitters are employed in creating representations of the signals transmitted by the transmitters. This is highly significant because it goes to the heart of the conceptional differences between the present invention and the D1 reference.

The Examiner has referred to Figure 4 in a number of places in the Written Opinion and in regard to that figure the Examiner should note the requirement for the creation of a channel estimate (402) as mentioned above. The creation of a channel estimate is in fact an extremely difficult thing to achieve and the present invention recognises this difficulty and therefore avoids the need for creating a channel estimate altogether. The Examiner should note, in particular, that the present invention uses the entire signal transmitted by a transmitter (i.e. all the power of that signal) in carrying out the steps of the invention. This is in distinction from the prior art where a known component (probably around 10%) is subtracted from the sample section of the received signal at the terminal. This creates a significant (around minus 10dB) loss in the signal-to-noise ratio which produces a significantly less accurate result.

Additionally, therefore D1 can be characterised by making one estimate and using a mathematical model rather than using two measurements in two different places (as per the present invention) and using one of the measurements to estimate the signal received from the other.

These differences are highly significant and we do not believe therefore that it is reasonable to suggest that the man skilled in the art would consider claim 1 or any of the independent claims to be obvious in view of the cited reference.

The Examiner has also commented on the conciseness of the set of claims, but as the Examiner will appreciate, national regulations concerning claim conciseness vary (in particular as regards the USA) and therefore the present multiple independent claims (which we believe all involve the same generic inventive concept) are maintained.

The Examiner has also suggested that the main independent claims should be put into two-part format. However, we believe that this would not provide significant advantages to the reader since the characterising clause would start so early in the claim. Furthermore, the two-part claim format is undesirable in certain jurisdictions and therefore any further amendment regarding claim format is proposed to be made in the national or regional phase. A reference to D1 has been incorporated on page 8. In view of the differences between D1 and the present invention described, we do not believe that references D2 and D3 provide the skilled man with any additional knowledge of relevance to the present invention and therefore no references have been incorporated to these two citations.

We look forward to receipt of the International Preliminary Examination Report in due course.

Yours faithfully
GILL JENNINGS & EVERY

Michael J Brunner

peaks are used to estimate the time offsets of the corresponding signals, giving sufficient independent timing measurements (three in this case) to compute a position fix.

If the peak 601 corresponding to the signals from Node B 203 is too weak to be resolved, a further iteration could be undertaken in which the signals from Node B 202 could be subtracted to yield a second residual signal (Figure 7). There is a clear correlation peak 701 at a delay of approximately 7 chips as expected.

WO-A-0055992 describes a synchronisation and cell search method for a terminal in a mobile telephone system, which uses an estimate of the communication channel (see Figure 4) to construct an estimate of a known synchronisation signal and correlates this with the received signal in order to allow cell identification.

In the prior art method of EP 01306115.5 discussed above, the assumption is made that the signal received at the terminal is a simple sum of the transmitted signals attenuated, phase rotated and delayed by the individual path lengths between transmitter and receiver. In a more complex system in which the transmission channel has incorporated non-linear effects, multi-path and noise, the transmitted signal is further degraded by these effects making the edges of the waveform less clearly defined in time. This process we have called a 'blurring' of the signal. When attempting to cancel a blurred signal, the process of subtracting only a simply scaled, delayed and phase rotated copy of the signal recorded by one sampling device from the signal received at the terminal may not remove the contribution from the transmitter associated with the one sampling device accurately enough. The present invention therefore provides improved methods which remove more accurately the contribution of the signals from the transmitter associated with the one sampling device from the signals received at the terminal by creating an equivalently 'blurred' estimate of the signal recorded at the terminal.

This process requires the creation of short sections of the recorded and sampled baseband representations of the signal to be used in the method. We have called such a section of data 'a section of the representation of the signal' in the following description.

A first aspect of the invention therefore provides a method of finding the time offset between signals transmitted by at least one of a plurality of transmitters of a

communications network and received by a receiver attached to a terminal, the method comprising the steps of

(a) creating at the terminal a section of a representation of the signals from the transmitters received by the receiver;

(b) creating a first section of a representation of the signal transmitted by a first of said transmitters, and creating a second section of a representation of the signal transmitted by a second of said transmitters, each of which sections overlaps in time with the section created at the terminal;

(c) creating a first function dependent on the first section and the section created at the terminal in step (a), and convolving the first section with the first function to form a blurred estimate of the signal received at the terminal from the first transmitter;

(d) creating a second function dependent on the first section and the section created at the terminal in step (a), and convolving the terminal section with the second function to form a blurred terminal section;

(e) subtracting the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(f) estimating the time offset between the blurred residual representation and the second section.

Preferably, the first function, which is used to create the blurred estimate, is a convolution of the first section of a representation of the signal transmitted by a first of said transmitters (the 'first section') with a cross-correlation of the section of a representation of the signals from the transmitters received by the receiver (the 'terminal section') and the first section. The above cross-correlation is preferably a windowed cross-correlation created by enhancing the significant components of the cross-correlation function.

Similarly, the second function, which is used to create the blurred terminal section, is a convolution of the terminal section with the auto-correlation profile of the first section.

Preferably, the blurred residual representation is cross-correlated with the second section of a representation of the signal transmitted by a second of said transmitters (the 'second section') to estimate the time offset.

Preferably, the first and second sections are created at the respective first and second transmitters, but they may be created elsewhere. They may be created in one or more sampling devices attached to the respective transmitters or located elsewhere, or they may be created by computer programs running anywhere in the communications network, or elsewhere, using information supplied from the network about the transmitted signals.

The various signal representation sections may be sent to one or more computing devices in which said estimates and time offsets, and a terminal location estimate, may be calculated. In some embodiments, the time offset between said section of a representation of the signals received by the receiver and said first section may first be calculated, and may then be used in the calculation of said terminal location estimate. The time offset between said section of a representation of the signals received by the receiver and said first section may be calculated using said sections or it may be calculated by other means, for example by calculating the time offset of a known component of the signal such as a pilot code. The time offset between said blurred residual representation and said second section may be calculated using said second section or it may be calculated by other means, for example by using a known component of the signal such as a pilot code.

The present invention thus overcomes the hearability problem by, for example, using a separate sampling device for each transmitter which sends to a computing device a representation of the signals transmitted only by that transmitter, by performing a cross-correlation of the representation sent back by the mobile terminal with the representation sent back by the sampling device associated with one of the transmitters to estimate the time offset between them, and by subtracting a blurred estimate of that signal from a blurred representation sent back by the mobile terminal, in order to reduce its effect on the remaining signals as far as possible. The cross-correlation and blurred subtraction steps may be iterated until no useful signals remain to be extracted. Simulations show that this provides a greater hearability gain than the straight subtraction method of the prior art of EP 01306115.5 while maintaining the advantages over IP-DL.

In some systems, the hearability problem may be solved simply by subtracting a blurred estimate of the signals received from just one transmitter, usually the brightest, from a blurred representation of the signals received at the terminal leaving a blurred residual representation in which the time offsets of the pilot codes, blurred

pilot codes or any other known portions of the transmitted signals, may be determined.

Thus a second aspect of the invention therefore provides a method of finding the time offset relative to a reference within the terminal of a component of a signal transmitted by one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the method comprising the steps of

(a) creating at the terminal a section of a representation of the signals from the transmitters received by the receiver (a "terminal section");

(b) creating a section of a representation of the signal transmitted by another transmitter (a "transmitter section"), which section overlaps in time with the section created at the terminal;

(c) creating a first function dependent on the terminal section and the transmitter section created in steps (a) and (b), and convolving the terminal section with the first function to form a blurred estimate of the signal received at the terminal from the other transmitter;

(d) creating a second function dependent on the terminal section and the transmitter section created in steps (a) and (b), and convolving the terminal section with the second function to form a blurred terminal section;

(e) subtracting the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(f) estimating the time offset between the blurred residual representation and the signal component.

Preferably, the first function, which is used to create the blurred estimate, is a convolution of the transmitter section with a cross-correlation of the terminal section and the transmitter section. This cross-correlation is preferably a windowed cross-correlation created by enhancing the significant components of the cross-correlation function.

Similarly, the second function, which is used to create the blurred terminal section, is a convolution of the terminal section with the auto-correlation profile of the transmitter section.

The known components of the transmitted signals in the second aspect of the invention may, for example, be the pilot codes. Before the time offset is estimated the known signal components may be blurred by convolution with another function.

In both the first and the second aspects of the invention, the section of the representation of the signals received by the receiver at the terminal may be recorded in the terminal before being sent to a computing device. Alternatively, the section may be transferred in real time to the computing device and a recording made there.

Preferably, the section of the representation of the signals transmitted by a transmitter is created at that transmitter, but it may be created elsewhere. It may be created in a sampling device attached to the transmitter or located elsewhere, or it may be created by a computer program running anywhere in the communications network, or elsewhere, using information supplied from the network about the transmitted signals. The calculations may be carried out in a computing device which may be in the handset or elsewhere, for example, a processor connected to the network.

The terminal may be a part of a positioning system, for example as described in any of EP-A-0767594, WO-A-9730360, AU-B-716647 EP-B-0303371, US-A-6094168 and EP-A-1025453 and may be a fixed device associated with a transmitter (for example, the 'fixed receiver' or 'Location Measurement Unit, LMU'), whose purpose is to receive signals from distant transmitters as well as from its associated transmitter, in which case the method of the invention includes the estimation of and subtraction of the signals from its associated transmitter in order to allow it to measure the time offsets of the signals received from distant transmitters.

The representation of the signals received by the receiver attached to the terminal may be a digitised version of the received signals converted first to baseband in the receiver. The representation of the signals transmitted by a transmitter may be a digitised version of the transmitted signals converted first to baseband.

In order to ensure an overlap of the respective sections, a suitably chosen component of the transmitted signals may be used to indicate the start of sampling.

The invention also includes apparatus including a processing means arranged to carry out the method of the first or second aspects of the invention described above.

The apparatus for carrying out the first aspect of the invention may comprise

(a) processing means arranged to create at the terminal a section of a representation of the signals from the transmitters received by the receiver;

(b) processing means arranged to create a first section of a representation of the signal transmitted by a first of said transmitters, and to create a second section of a representation of the signal transmitted by a second of said transmitters, each of which sections overlaps in time with the section created at the terminal;

(c) processing means arranged to create a first function dependent on the first section and the section created at the terminal in step (a), and convolve the first section with the first function to form a blurred estimate of the signal received at the terminal from the first transmitter;

(d) processing means arranged to create a second function dependent on the first section and the section created at the terminal in step (a), and convolve the terminal section with the second function to form a blurred terminal section;

(e) processing means arranged to subtract the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(f) processing means arranged to estimate the time offset between the blurred residual representation and the second section.

The apparatus for carrying out the second aspect of the invention, for finding the time offset relative to a reference within the terminal of a component of a signal transmitted by one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, may comprise

(a) processing means arranged to create at the terminal a section of a representation of the signals from the transmitters received by the receiver (a "terminal section");

(b) processing means arranged to create a section of a representation of the signal transmitted by an other transmitter (a "transmitter section");

(c) processing means arranged to create a first function dependent on the terminal section and the transmitter section created in steps (a) and (b), and convolve the terminal section with the first function to form a blurred estimate of the signal received at the terminal from the other transmitter;

(d) processing means arranged to create a second function dependent on the terminal section and the transmitter section created in steps (a) and (b), and convolve the terminal section with the second function to form a blurred terminal section;

(e) processing means arranged to subtract the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(f) processing means arranged to estimate the time offset between the blurred residual representation and the signal component.

The apparatus may be disposed in a handset or other terminal of a telecommunications network.

The invention also includes a communications network for carrying out the first aspect of the invention, the network comprising

(a) a computing device or devices;

(b) a terminal having a radio receiver attached to the terminal, means for creating a section of a representation of the signals, received by the radio receiver, from the transmitters of the communications network, and means for sending the section to the computing device or devices;

(c) sampling devices associated with respective first and second of said transmitters for creating respective first and second sections of representations of the signal transmitted by the respective transmitter which overlap in time with the section created at the terminal, and for sending the sections of the representations created at said transmitters to said computing device or devices;

the computing device or devices being adapted to perform

1 creation of a first function dependent on the first section and the section created at the terminal, and a convolution of the first section with the first function to provide a blurred estimate of the signal received at the terminal from the first transmitter;

2 creation of a second function dependent on the first section and the section created at the terminal, and a convolution of the section created at the terminal with the second function to provide a blurred terminal section;

3 a subtraction of said blurred estimate from the blurred terminal section to produce a blurred residual representation;

4 a calculation of the time offset between the blurred residual representation and said second section.

A calculation of the position of the terminal may be made using said time offset.

The invention also includes a communications network for carrying out the second aspect of the invention, for finding the time offset relative to a reference within the terminal of a component of a signal transmitted by one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the network comprising

(a) a computing device or devices;

(b) a terminal having a radio receiver attached to the terminal, means for creating a section of a representation of the signals, received by the radio receiver, from the transmitters of the communications network (a "terminal section"), and means for sending the section to the computing device or devices;

(c) a sampling device associated with an other transmitter for creating a section of a representation of the signal transmitted by the other transmitter (a "transmitter section") which overlaps in time with the section created at the terminal, and for sending the section of the representations created at the other transmitter to said computing device or devices;

the computing device or devices being adapted to perform

1 creation of a first function dependent on the transmitter section and the terminal section, and a convolution of the transmitter section with the first function to provide a blurred estimate of the signal received at the terminal from the other transmitter;

2 creation of a second function dependent on the transmitter section and the terminal section, and a convolution of the terminal section with the second function to provide a blurred terminal section;

3 a subtraction of said blurred estimate from the blurred terminal section to produce a blurred residual representation;

4 a calculation of the time offset between the blurred residual representation and the signal component.

A calculation of the position of the terminal may be made using said time offset.

The E-OTD positioning systems described generally above work with unsynchronised networks, i.e. any common component of the signals transmitted by any one transmitter is not synchronised in time with the transmission of that component by any other of the transmitters, but instead is transmitted after an unknown time delay, sometimes called the Relative Transmission Delay (RTD). The position calculation requires that this delay is known, and so the positioning systems employ fixed receivers at known locations throughout the network which are set up to measure the transmitted signals and compute the RTDs. It has been described above how the hearability problem hinders the straightforward application of the E-OTD techniques to direct-sequence CDMA systems. However, the second aspect of the present invention overcomes the hearability problem by allowing the very strong signals from a local transmitter to be subtracted from the signals received by the fixed receiver, thus allowing the much weaker signals from the distant transmitters to be measured.

The method of application of E-OTD to CDMA systems then follows that described, for example, in our EP-A-1025453.

The invention also includes one or more computing devices in which the calculations described herein above are made.

The means for carrying out the calculations in the computing device or devices may be components of hardware and/or software.

Therefore, the invention includes a computer program or programs having computer program code means for carrying out the steps performed in the computing device or devices as described above.

CLAIMS

1. A method of finding the time offset between signals transmitted by at least one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the method comprising the steps of

(a) creating at the terminal a section of a representation of the signals from the transmitters received by the receiver;

(b) creating a first section of a representation of the signal transmitted by a first of said transmitters, and creating a second section of a representation of the signal transmitted by a second of said transmitters, each of which sections overlaps in time with the section created at the terminal;

(c) creating a first function dependent on the first section and the section created at the terminal in step (a), and convolving the first section with the first function to form a blurred estimate of the signal received at the terminal from the first transmitter;

(d) creating a second function dependent on the first section and the section created at the terminal in step (a), and convolving the terminal section with the second function to form a blurred terminal section;

(e) subtracting the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(f) estimating the time offset between the blurred residual representation and the second section.

2. A method according to claim 1, wherein the first function, which is used to create the blurred estimate, is a convolution of the first section of a representation of the signal transmitted by a first of said transmitters (the 'first section') with a cross-correlation of the section of a representation of the signals from the transmitters received by the receiver (the 'terminal section') and the first section.

3. A method according to claim 2, wherein the cross-correlation is a windowed cross-correlation created by enhancing the significant components of the cross-correlation function.

4. A method according to any of claims 1 to 3, wherein the second function, which is used to create the blurred terminal section, is a convolution of the terminal section with the auto-correlation profile of the first section.

5. A method according to any of claims 1 to 4, wherein the blurred residual representation is cross-correlated with the second section of a representation of the signal transmitted by a second of said transmitters (the 'second section') to estimate the time offset.

6. A method according to any of claims 1 to 5, wherein the first and second sections are created at the respective first and second transmitters.

7. A method according to any of claims 1 to 5, wherein the first and second sections are created in one or more sampling devices attached to the respective transmitters or located elsewhere.

8. A method according to any of claims 1 to 5, wherein the first and second sections are created by computer programs running anywhere in the communications network, or elsewhere, using information supplied from the network about the transmitted signals.

9. A method of finding the time offset relative to a reference within the terminal of a component of a signal transmitted by one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the method comprising the steps of

(a) creating at the terminal a section of a representation of the signals from the transmitters received by the receiver (a "terminal section");

(b) creating a section of a representation of the signal transmitted by an other transmitter (a "transmitter section"), which section overlaps in time with the section created at the terminal;

(c) creating a first function dependent on the terminal section and the transmitter section created in steps (a) and (b), and convolving the terminal section with the first function to form a blurred estimate of the signal received at the terminal from the other transmitter;

(d) creating a second function dependent on the terminal section and the transmitter section created in steps (a) and (b), and convolving the terminal section with the second function to form a blurred terminal section;

(e) subtracting the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(f) estimating the time offset between the blurred residual representation and the signal component.

10. A method according to claim 9, wherein the first function, which is used to create the blurred estimate, is a convolution of the transmitter section with a cross-correlation of the terminal section and the transmitter section.

11. A method according to claim 10, wherein the cross-correlation is a windowed cross-correlation created by enhancing the significant components of the cross-correlation function.

12. A method according to any of claims 9 to 11, wherein the second function, which is used to create the blurred terminal section, is a convolution of the terminal section with the auto-correlation profile of the transmitter section.

13. A method according to any of claims 9 to 12, wherein the known components of the transmitted signals in the second aspect of the invention are pilot codes.

14. A method according to any of claims 9 to 13, wherein, before the time offset is estimated, the known signal components are blurred by convolution with another function.

15. A method according to any of claims 9 to 14, wherein the section of the representation of the signals transmitted by a transmitter is created at that transmitter.

16. A method according to any of claims 9 to 14, wherein the section of the representation of the signals transmitted by a transmitter is created in one or more sampling devices attached to the respective transmitters or located elsewhere.

17. A method according to any of claims 9 to 14, wherein the section of the representation of the signals transmitted by a transmitter is created by a computer program running anywhere in the communications network, or elsewhere, using information supplied from the network about the transmitted signals.

18. A method according to any of claims 1 to 14, wherein the section of the representation of the signals received by the receiver at the terminal is recorded in the terminal before being sent to a computing device.

19. A method according to any of claims 1 to 14, wherein the section of the representation of the signals received by the receiver at the terminal is transferred in real time to the computing device and a recording made there.

20. A method according to any of claims 1 to 19, wherein the representation of the signals received by the receiver attached to the terminal may be a digitised version of the received signals converted first to baseband in the receiver.

21. A method according to any of claims 1 to 20, wherein the representation of the signals transmitted by a transmitter may be a digitised version of the transmitted signals converted first to baseband.

22. Apparatus including a processing means arranged to carry out the method of any of claims 1 to 21.

23. Apparatus for finding the time offset between signals transmitted by at least one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the apparatus comprising

(a) processing means arranged to create at the terminal a section of a representation of the signals from the transmitters received by the receiver;

(b) processing means arranged to create a first section of a representation of the signal transmitted by a first of said transmitters, and to create a second section of a representation of the signal transmitted by a second of said transmitters, each of which sections overlaps in time with the section created at the terminal;

(c) processing means arranged to create a first function dependent on the first section and the section created at the terminal in step (a), and convolve the first section with the first function to form a blurred estimate of the signal received at the terminal from the first transmitter;

(d) processing means arranged to create a second function dependent on the first section and the section created at the terminal in step (a), and convolve the terminal section with the second function to form a blurred terminal section;

(e) processing means arranged to subtract the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(f) processing means arranged to estimate the time offset between the blurred residual representation and the second section.

24. Apparatus for finding the time offset relative to a reference within the terminal of a component of a signal transmitted by one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the apparatus comprising

(a) processing means arranged to create at the terminal a section of a representation of the signals from the transmitters received by the receiver (a "terminal section");

(b) processing means arranged to create a section of a representation of the signal transmitted by an other transmitter (a "transmitter section");

(c) processing means arranged to create a first function dependent on the terminal section and the transmitter section created in steps (a) and (b), and convolve the terminal section with the first function to form a blurred estimate of the signal received at the terminal from the other transmitter;

(d) processing means arranged to create a second function dependent on the terminal section and the transmitter section created in steps (a) and (b), and convolve the terminal section with the second function to form a blurred terminal section;

(e) processing means arranged to subtract the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(f) processing means arranged to estimate the time offset between the blurred residual representation and the signal component.

25. A telecommunications terminal including apparatus for finding the time offset between signals transmitted by at least one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the apparatus comprising

(a) processing means arranged to create at the terminal a section of a representation of the signals from the transmitters received by the receiver;

(b) processing means arranged to create a first function dependent on a first section of a representation of the signal transmitted by a first of said transmitters which overlaps in time with the section created at the terminal and which is sent to the terminal and the section created at the terminal in step (a), and convolve the first section with the first function to form a blurred estimate of the signal received at the terminal from the first transmitter ;

(c) processing means arranged to create a second function dependent on the first section and the section created at the terminal in step (a), and convolve the section created at the terminal with the second function to form a blurred terminal section;

(d) processing means arranged to subtract the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(e) processing means arranged to estimate the time offset between the blurred residual representation and a second section of a representation of the signal transmitted by a second of said transmitters which overlaps in time with the section created at the terminal and which is sent to the terminal.

26. A telecommunications terminal including apparatus for finding the time offset relative to a reference within the terminal of a component of a signal transmitted by one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the apparatus comprising

(a) processing means arranged to create at the terminal a section of a representation of the signals from the transmitters received by the receiver (a "terminal section");

(b) processing means arranged to create a first function dependent on the terminal section and a section of a representation of the signal transmitted by another transmitter (a "transmitter section") which is sent to the terminal, and convolve the terminal section with the first function to form a blurred estimate of the signal received at the terminal from theother transmitter;

(c) processing means arranged to create a second function dependent on the transmitter section and the terminal section created at the terminal, and convolve the terminal section with the second function to form a blurred terminal section;

(d) processing means arranged to subtract the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(e) processing means arranged to estimate the time offset between the blurred residual representation and the signal component.

27. A communications network for finding the time offset between signals transmitted by at least one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the network comprising

(a) a computing device or devices;

(b) a terminal having a radio receiver attached to the terminal, means for creating a section of a representation of the signals, received by the radio receiver, from the transmitters of the communications network, and means for sending the section to the computing device or devices;

(c) sampling devices associated with respective first and second of said transmitters for creating respective first and second sections of

representations of the signal transmitted by the respective transmitter which overlap in time with the section created at the terminal, and for sending the sections of the representations created at said transmitters to said computing device or devices;

the computing device or devices being adapted to perform

1 creation of a first function dependent on the first section and the section created at the terminal, and a convolution of the first section with the first function to provide a blurred estimate of the signal received at the terminal from the first transmitter;

2 creation of a second function dependent on the first section and the section created at the terminal, and a convolution of the section created at the terminal with the second function to provide a blurred terminal section;

3 a subtraction of said blurred estimate from the blurred terminal section to produce a blurred residual representation;

4 a calculation of the time offset between the blurred residual representation and said second section.

28. A communications network for finding the time offset relative to a reference within the terminal of a component of a signal transmitted by one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the network comprising

(a) a computing device or devices;

(b) a terminal having a radio receiver attached to the terminal, means for creating a section of a representation of the signals, received by the radio receiver, from the transmitters of the communications network (a "terminal section"), and means for sending the section to the computing device or devices;

(c) a sampling device associated with an other transmitter for creating a section of a representation of the signal transmitted by the other transmitter (a "transmitter section") which overlaps in time with the section created at the terminal, and for sending the section of the representations created at the other transmitter to said computing device or devices;

the computing device or devices being adapted to perform

1 creation of a first function dependent on the transmitter section and the terminal section, and a convolution of the transmitter section with the first function to provide a blurred estimate of the signal received at the terminal from the other transmitter;

2 creation of a second function dependent on the transmitter section and the terminal section, and a convolution of the terminal section with the second function to provide a blurred terminal section;

3 a subtraction of said blurred estimate from the blurred terminal section to produce a blurred residual representation;

4 a calculation of the time offset between the blurred residual representation and the signal component.

29. A computing device or devices for use in a communications network comprising a terminal having a radio receiver attached to the terminal, means for creating a section of a representation of the signals, received by the radio receiver, from the transmitters of the communications network, and means for sending the section to the computing device or devices; and sampling devices associated with respective first and second of said transmitters for creating respective first and second sections of representations of the signal transmitted by the respective transmitter which overlap in time with the section created at the terminal, and for sending the sections of the representations created at said transmitters to said computing device or devices,

the computing device or devices being adapted to perform

1 creation of a first function dependent on the first section and the section created at the terminal, and a convolution of the first section with the first function to provide a blurred estimate of the signal received at the terminal from the first transmitter;

2 creation of a second function dependent on the first section and the section created at the terminal, and a convolution of the section created at the terminal with the second function to provide a blurred terminal section;

3 a subtraction of said blurred estimate from the blurred terminal section to produce a blurred residual representation;

4 a calculation of the time offset between the blurred residual representation and said second section.

30. A computing device or devices for use in a communications network comprising a terminal having a radio receiver attached to the terminal, means for creating a section of a representation of the signals, received by the radio receiver, from the transmitters of the communications network (a "terminal section"), and means for sending the section to the computing device or devices; and a sampling device associated with an other transmitter for creating a section of a representation

of the signal transmitted by the other transmitter (a "transmitter section") which overlaps in time with the section created at the terminal, and for sending the section of the representations created at the other transmitter to said computing device or devices,

the computing device or devices being adapted to perform

1 creation of a first function dependent on the transmitter section and the terminal section, and a convolution of the transmitter section with the first function to provide a blurred estimate of the signal received at the terminal from the other transmitter;

2 creation of a second function dependent on the transmitter section and the terminal section, and a convolution of the terminal section with the second function to provide a blurred terminal section;

3 a subtraction of said blurred estimate from the blurred terminal section to produce a blurred residual representation;

4 a calculation of the time offset between the blurred residual representation and the signal component.

31. A computer program or programs comprising computer program code means adapted to perform the steps of the computing device of claim 29.

32. A computer program or programs comprising computer program code means adapted to perform the steps of the computing device of claim 30.

33. A method of calculating the position of a mobile terminal in a communications network which includes the method of any of claims 1 to 21.